ZooKeys 529: 71–86 (2015)
doi: 10.3897/zookeys.529.6326
http://zookeys.pensoft.net

RESEARCH ARTICLE

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Contributions to the knowledge of oribatid mites of Indonesia. 1. The genus *Allogalumna* (Galumnidae) with descriptions of two new species (Acari, Oribatida)

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Academic editor: *V. Pesic* | Received 24 August 2015 | Accepted 15 September 2015 | Published 26 October 2015

http://zoobank.org/564E4BAC-AA42-491F-89E5-B5AA8E8AC5B3

Citation: Ermilov SG, Sandmann D, Klarner B, Widyastuti R, Scheu S (2015) Contributions to the knowledge of oribatid mites of Indonesia. 1. The genus *Allogalumna* (Galumnidae) with descriptions of two new species (Acari, Oribatida). ZooKeys 529: 71–86. doi: 10.3897/zookeys.529.6326

Abstract

Two new species of oribatid mites of the genus *Allogalumna* (Oribatida, Galumnidae) are described from litter and soil materials of Sumatra, Indonesia. *Allogalumna indonesiensis* **sp. n.** is morphologically most similar to *A. borhidii* Balogh & Mahunka, 1979, *A. quadrimaculata* (Mahunka, 1988), *A. rotundiceps* Aoki, 1996 and *A. plowmanae* Balogh & Balogh, 1983; however, the new species differs by having densely ciliate bothridial heads, larger body size and absence of a median pore. *Allogalumna paranovazealandica* **sp. n.** is morphologically most similar to *A. novazealandica* Hammer, 1968; however, the new species differs by the shorter body length and barbed and curving postero-laterad bothridial setae. The genus *Allogalumna* is recorded for the first time in the Indonesian fauna.

Keywords

Oribatid mites, *Allogalumna*, new species, new record, Indonesia

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Introduction

At present, the oribatid mite fauna (Acari, Oribatida) of Indonesia is poorly known (Sellnick 1925, 1930; Willmann 1929, 1932; Csiszár 1961; Balogh and Mahunka 1968; Mahunka 1977, 1989, 1990; Hammer 1979, 1981a, 1981b, 1982; Aoki et al. 1994; Niedbała 2007, 2008). This work is a part of a study on Indonesian oribatids and based on material which was collected in 2013 in the framework of the interdisciplinary project "Ecological and socioeconomic functions of tropical lowland rainforest transformation systems (Sumatra, Indonesia)". Litter and soil samples were taken along a land use gradient including rainforest, jungle rubber, rubber and oil palm plantations in Jambi Province. For more details on the study region and experimental design see Barnes et al. (2014).

This paper includes the data on taxa of *Allogalumna* Grandjean, 1936 (Galumnidae). During taxonomic identification, two new species of this genus were found. The main goal of the paper is to describe and illustrate these species under the names *A. indonesiensis* sp. n. and *A. paranovazealandica* sp. n.

Allogalumna is a genus that was proposed by Grandjean (1936) with *Galumna alamellae* Jacot, 1935 as type species. Based on updated generic diagnosis (Ermilov et al. 2013a), it comprises more than 40[1] species collectively having a cosmopolitan distribution; *Allogalumna* has not been reported before in the Indonesian fauna. An identification key to all known species of this genus was given by Akrami (2015), while additional keys to selective species were presented by Balogh and Balogh (2002) and Ermilov and Anichkin (2014).

Materials and methods

Exact collection locality and habitat are given in the respective "Material examined" section for each new species.

Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulae for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulae for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus.

General terminology used in this paper follows that of Grandjean (summarized by Norton and Behan-Pelletier 2009).

Drawings were made with a camera lucida using a Carl Zeiss transmission light microscope "Axioskop-2 Plus".

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[1] Subías (2004, updated 2015) included 37 species in *Allogalumna*.

Descriptions

***Allogalumna indonesiensis* sp. n.**
http://zoobank.org/2E8C0C04-C670-4191-AA46-3134623A5D09
Figs 1–9

Diagnosis. Body size: 282–298 × 215–232. Rostral, lamellar and interlamellar setae minute. Bothridial setae with unilaterally dilated, densely ciliate head. Anterior notogastral margin not developed. Four pairs of porose areas rounded. Median pore absent. Postanal porose area elongate oval.

Description. *Measurements.* Body length: 282 (holotype: male), 282–298 (five paratypes: two females and three males); notogaster width: 215 (holotype), 215–232 (five paratypes). Without sexual dimorphism.

Integument. Body color brown. Body surface, pteromorphs, subcapitular mentum, genital and anal plates, and legs smooth.

Prodorsum (Figs 1, 3, 5). Rostrum broadly rounded. Sublamellar lines (*S*) distinct, curving backwards. Rostral (*ro*), lamellar (*le*) and interlamellar (*in*) setae minute (all 4), thin, smooth. Bothridial setae (*bs*) comparatively short (49–53), with unilaterally dilated, densely ciliate head. Exobothridial setae and their alveoli absent. Porose areas *Ad* elongate oval, transversally oriented (16–20 × 6–8).

Notogaster (Figs 1, 3, 4). Anterior notogastral margin not developed. Dorsophragmata (*D*) of medium size, elongated longitudinally. Notogastral setae represented by 10 pairs of alveoli. Four pairs of porose areas rounded, with distinct margins: *Aa* (16–18) usually slightly larger than *A1*, *A2* and *A3* (all 12–16). Setal alveoli *la* inserted posteriorly to *Aa*. Median pore absent in males and females. All lyrifissures (*ia*, *im*, *ip*, *ih*, *ips*) distinct, *im* located between setal alveoli *lm* and *lp*. Opisthonotal gland openings (*gla*) located laterally to *A1*.

Gnathosoma (Fig. 6). Morphology of subcapitulum, palps and chelicerae typical for most Galumnidae (for example, see Engelbrecht 1969, 1972; Ermilov and Anichkin 2010, 2011; Ermilov et al. 2011, 2013b; Bayartogtokh and Akrami 2014). Subcapitulum size: 61–69 × 61–69. Subcapitular setae setiform, smooth, *a* (10–12) longer than *m* (6–8) and *h* (4), *a* thickest, *h* thinnest. Two pairs of adoral setae (or_1, or_2, 8) thin, indistinctly barbed. Palps (57) with typical setation: 0–2–1–3–9(+ω). Axillary sacculi (*sac*) distinct. Chelicerae (77) with two setiform, barbed setae; *cha* (28) longer than *chb* (16). Trägårdh's organ long, tapered.

Epimeral and lateral podosomal regions (Fig. 2). Anterior tectum of epimere I smooth. Apodemes 1, 2, sejugal and 3 well visible. Four pairs of short (all 4), thin setae, setal formula: 1–0–1–2. Pedotecta II (Pd II) scale-like in lateral view, rounded distally in ventral view. Discidia (*dis*) sharply triangular. Circumpedal carinae (*cp*) distinct, directed slightly laterally to setae *3b*.

Anogenital region (Figs 2, 4, 7, 8). Six pairs of genital (g_1, 8; g_2–g_6, 4), one pair of aggenital (*ag*, 4), two pairs of anal (an_1, an_2, 4) and three pairs of adanal (ad_1–ad_3, 4) setae thin, smooth. Two genital setae on anterior edge of each genital plate. Adanal se-

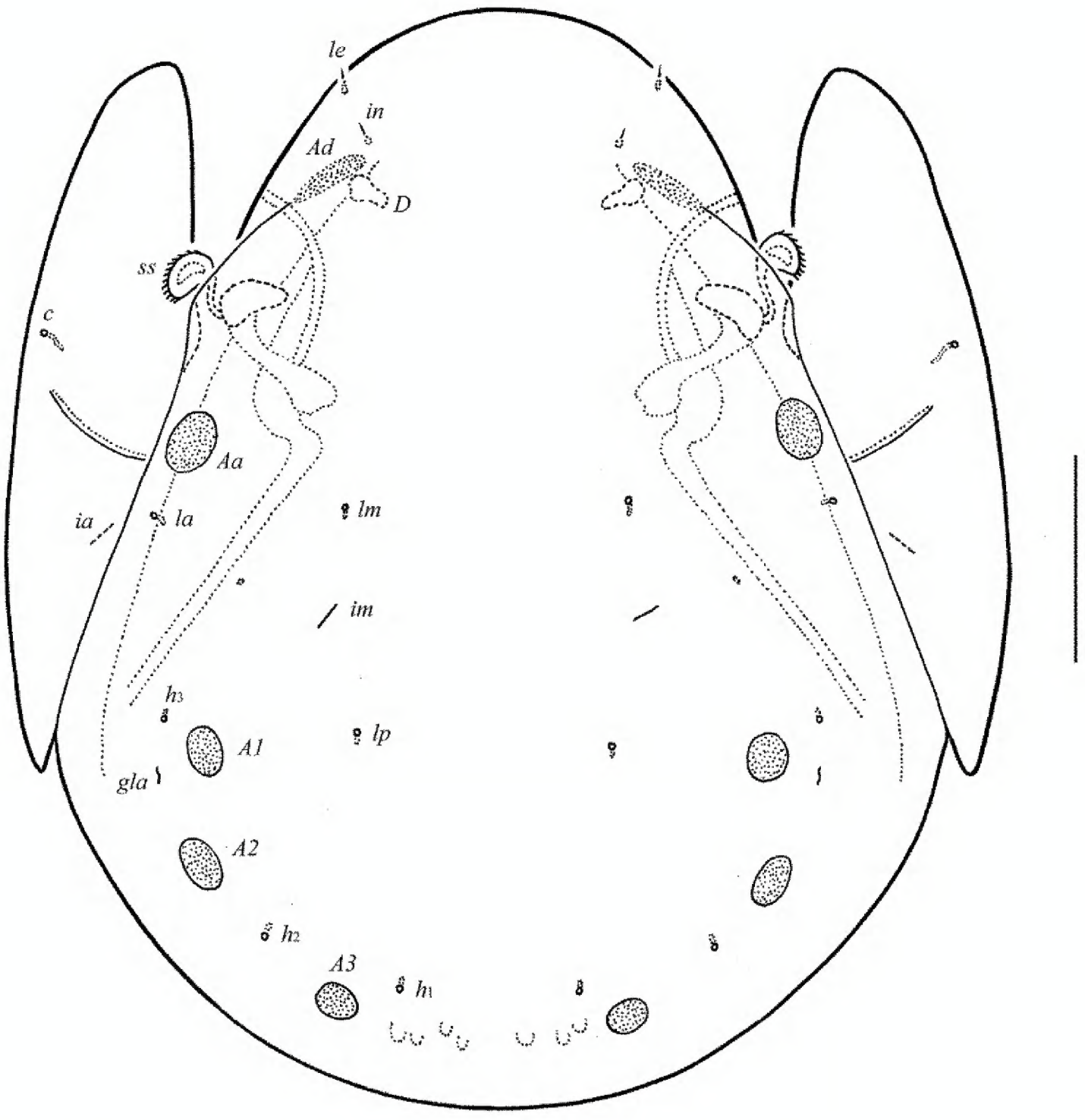


Figure 1. *Allogalumna indonesiensis* sp. n., adult: dorsal view. Scale bar 50 μm.

tae ad_3 inserted laterally to adanal lyrifissures (*iad*). Postanal porose area (*Ap*) elongate oval, transversally oriented (28–32 × 6–8).

Legs (Fig. 9). Morphology of leg segments, setae and solenidia typical for most Galumnidae (for example, see Engelbrecht 1969, 1972; Ermilov and Anichkin 2010, 2011; Ermilov et al. 2011; Bayartogtokh and Akrami 2014). Tridactylous; claws smooth. Formulas of leg setation and solenidia: I (1–4–3–4–20) [1–2–2], II (1–4–3–4–15) [1–1–2], III (1–2–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Solenidion φ of tibiae IV inserted dorsally at about 2/3 length of segment.

Material examined. Holotype (male): Indonesia, Sumatra, Harapan landscape, Jungle rubber agroforest, research site HJ2 (project site number), 01°49'31.9"S, 103°17'39.2"E,

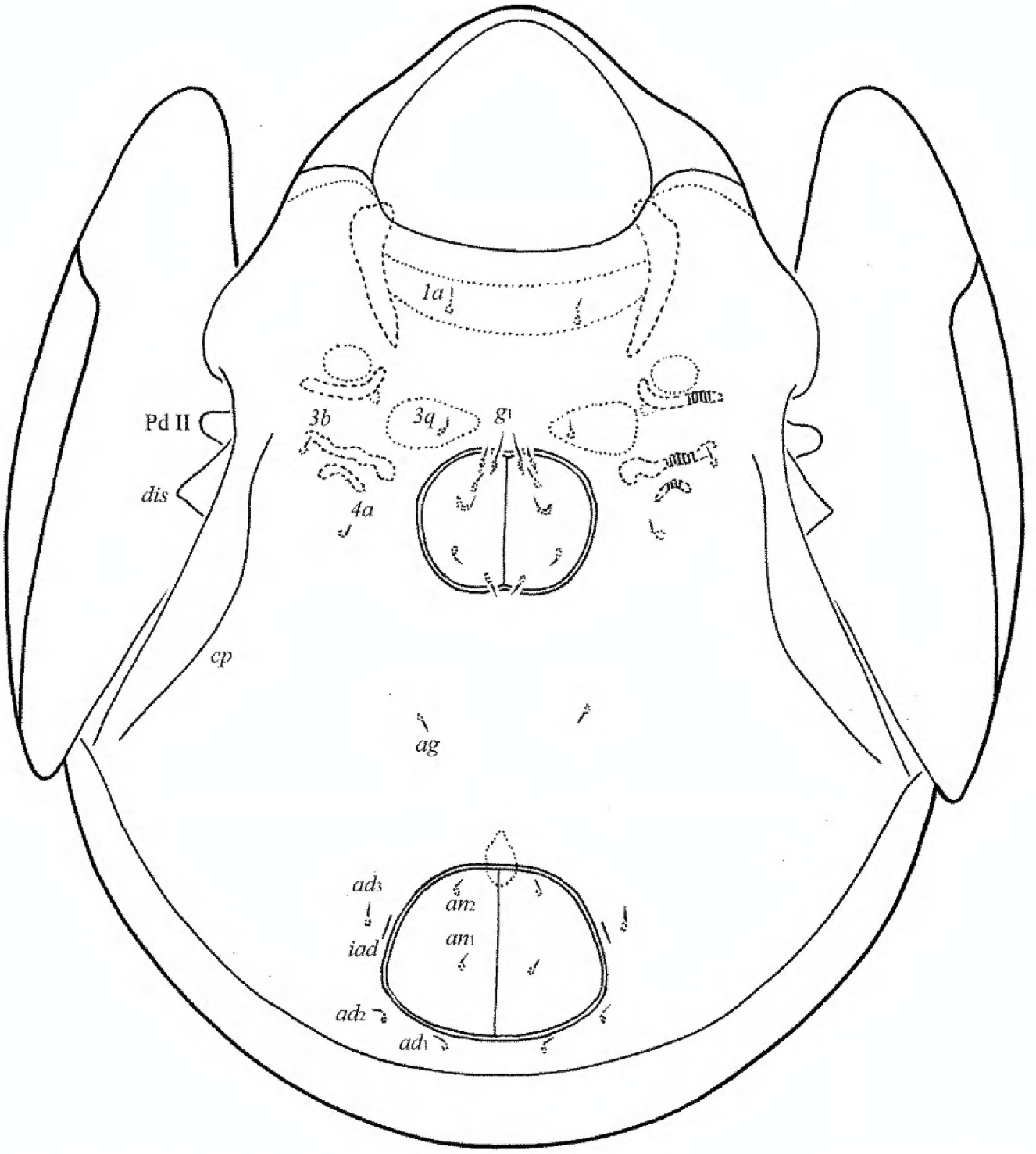
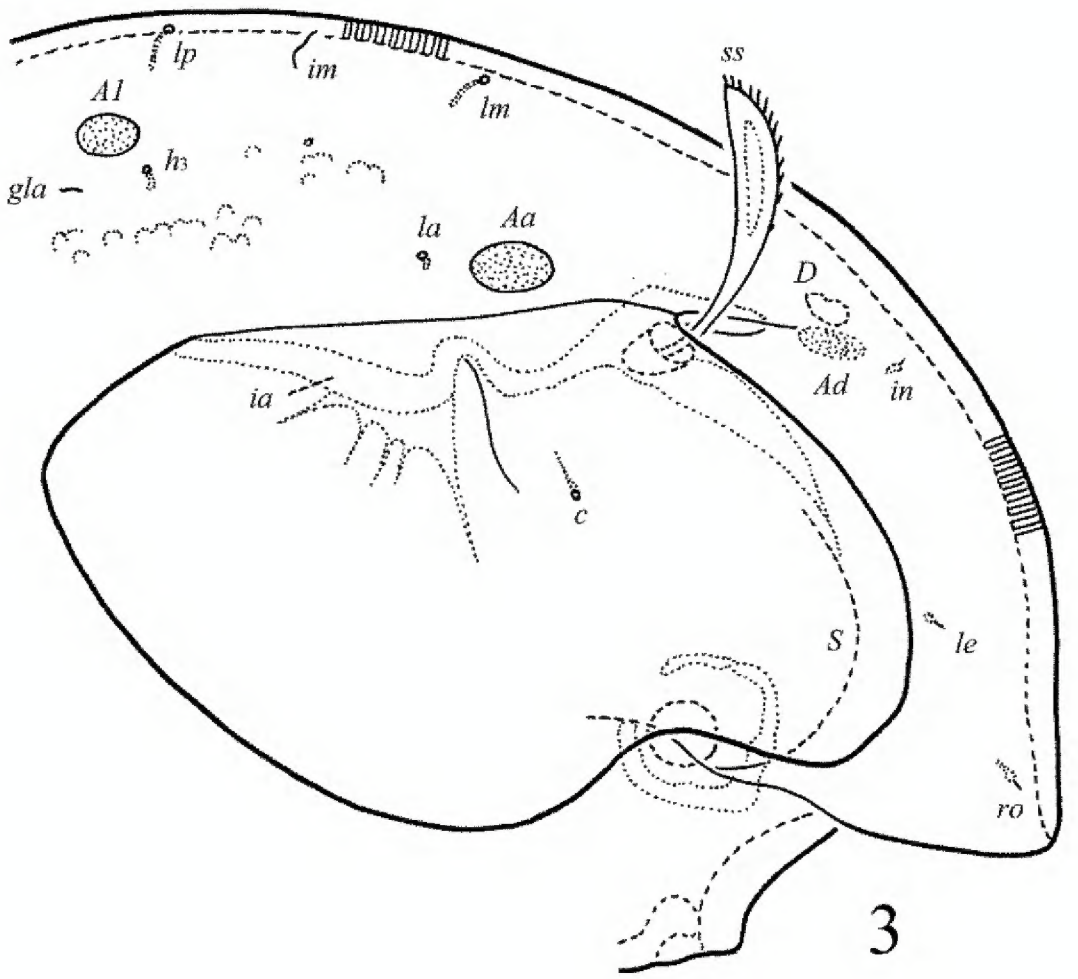


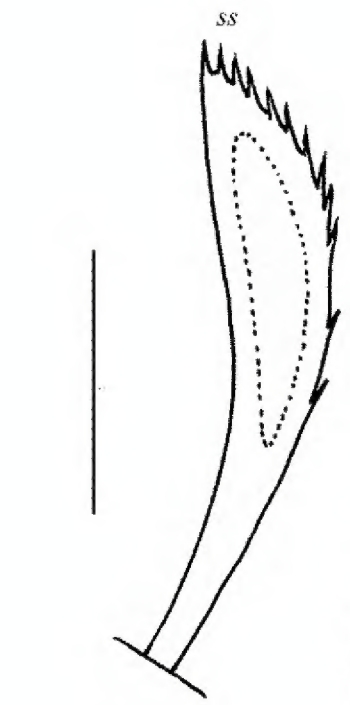
Figure 2. *Allogalumna indonesiensis* sp. n., adult: ventral view (gnathosoma and legs not shown). Scale bar 50 μm.

84 m a.s.l., from forest floor litter material. Two paratypes (female and male): Indonesia, Sumatra, Bukit Duabelas landscape, secondary rainforest, research site BF1, 01°59'42.5"S, 102°45'08.1"E, 83 m a.s.l., from forest floor litter material. Three paratypes (female and two males): Indonesia, Sumatra, Bukit Duabelas landscape, Jungle rubber agroforest, research site BJ5, 02°08'35.6"S, E 102°51'04.7"E, 51 m a.s.l., from upper soil layer (0–5 cm). All specimens were collected by Bernhard Klarner (15.XI.2013) and determined and collected to morphospecies level by Dorothee Sandmann.

Type deposition. The holotype is deposited in LIPI (Indonesian Institute of Science) Cibinong, Indonesia; three paratypes are deposited in the collection of the Senckenberg Museum, Görlitz, Germany; two paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.



Figures 3–4. *Allogalumna indonesiensis* sp. n., adult: **3** anterior part of body, lateral view (gnathosoma and leg I not shown) **4** posterior view. Scale bar 50 μm.



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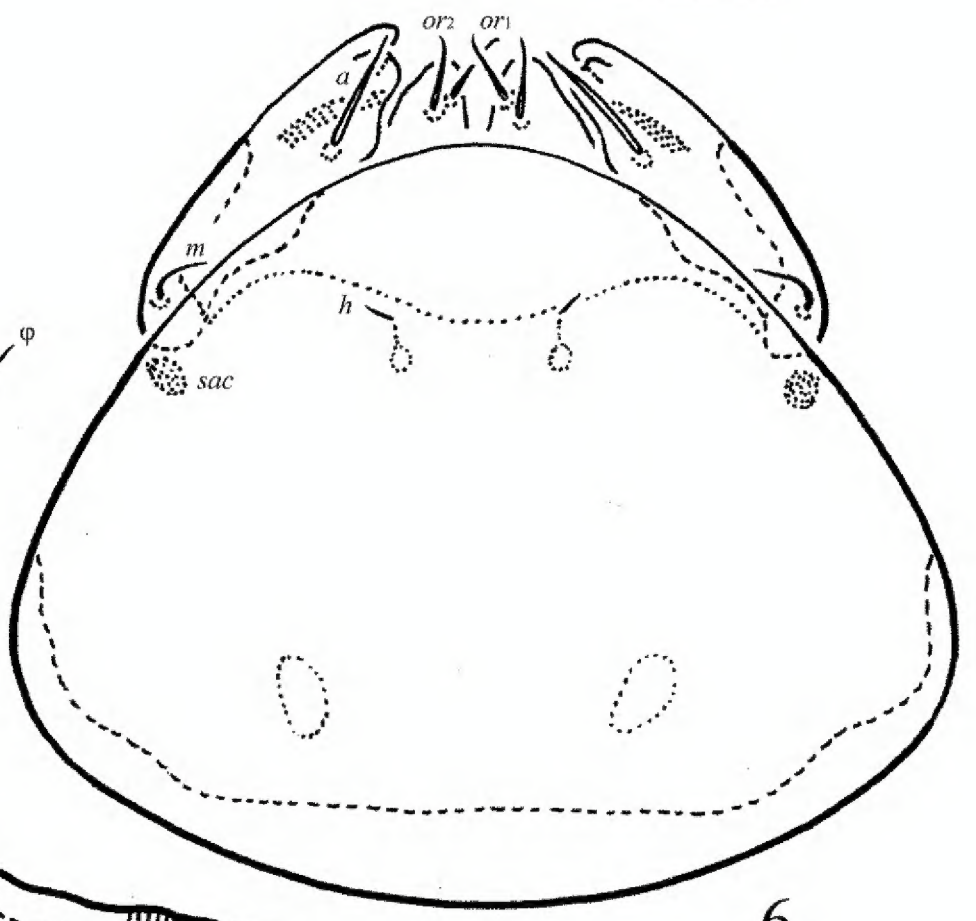

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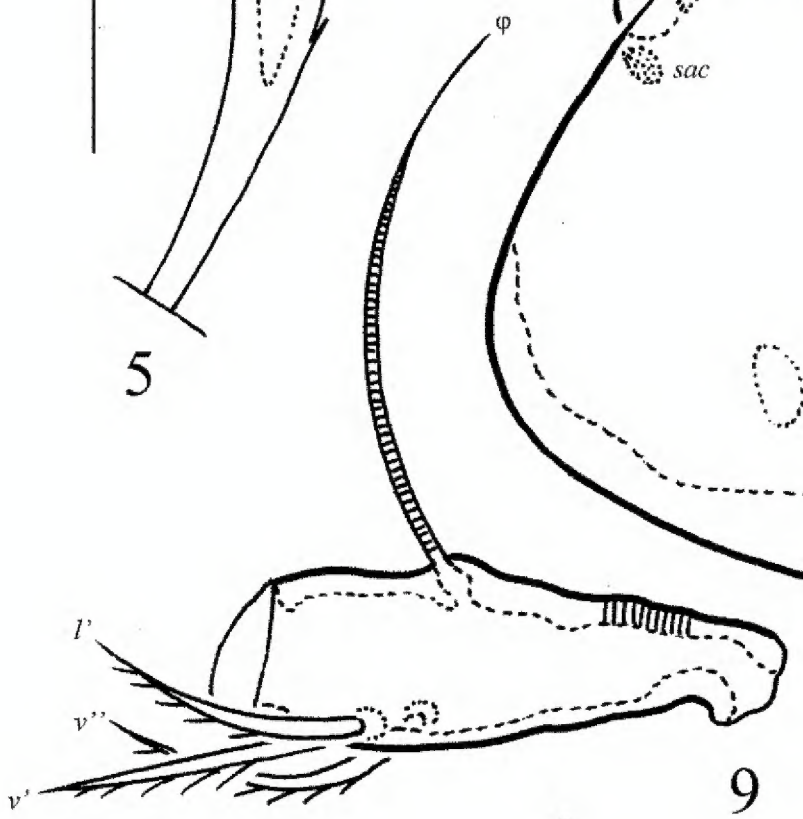

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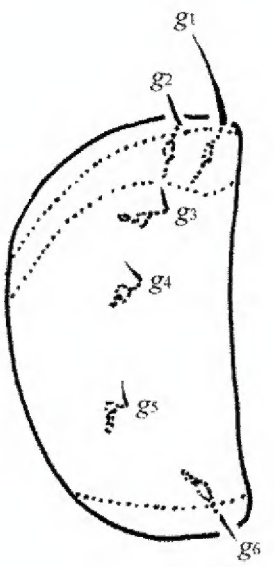

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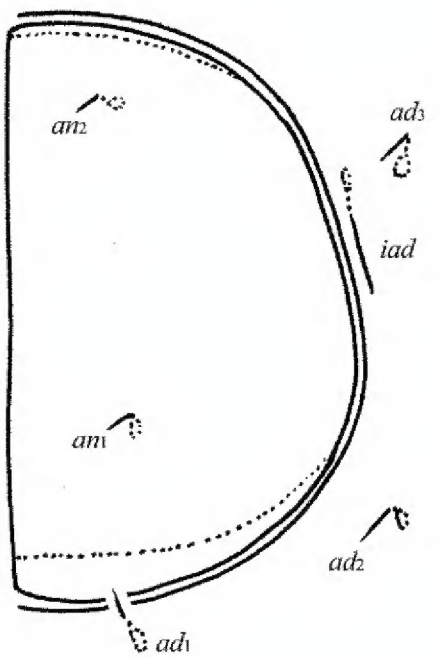

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Figures 5–9. *Allogalumna indonesiensis* sp. n., adult: **5** bothridial seta **6** subcapitulum, ventral view **7** genital plate, right **8** anal plate, left, and adanal setae **9** tibia of leg IV, right, antiaxial view. Scale bar 20 μm.

Table 1. Leg setation and solenidia of adult *Allogalumna indonesiensis* sp. n. (same data for *A. paranovazealandica* sp. n.)

Leg	Tr	Fe	Ge	Ti	Ta
I	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, ε	(*l*), (*v*), φ_1, φ_2	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), *v'*, (*pl*), *l"*, ε, ω_1, ω_2
II	*v'*	*d*, (*l*), *bv"*	(*l*), *v'*, σ	(*l*), (*v*), φ	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), ω_1, ω_2
III	*v'*	*d*, *ev'*	*l'*, σ	*l'*, (*v*), φ	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*)
IV	*v'*	*d*, *ev'*	*d*, *l'*	*l'*, (*v*), φ	*ft"*, (*tc*), (*p*), (*u*), (*a*), *s*, (*pv*)

Note: Roman letters refer to normal setae, Greek letters to solenidia (except ε = famulus). Single prime (') marks setae on the anterior and double prime (") setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae. Tr – trochanter, Fe – femur, Ge – genu, Ti – Tibia, Ta – tarsus.

Etymology. The specific name *indonesiensis* refers to the country of origin, Indonesia.

Remarks. *Allogalumna indonesiensis* sp. n. is most similar to *A. borhidii* Balogh & Mahunka, 1979 from the Neotropical region (see Balogh and Mahunka 1979), *A. quadrimaculata* (Mahunka, 1988) from Malaysia (see Mahunka 1988), *A. rotundiceps* Aoki, 1996 from Japan and Vietnam (see Aoki 1996) and *A. plowmanae* Balogh & Balogh, 1983 from Australia (see Balogh and Balogh 1983) in having small body size, minute prodorsal setae, four pairs of rounded notogastral porose areas and bothridial setae with unilaterally dilated head. However, the new species differs from these species by having densely ciliate bothridial heads (versus slightly barbed in distal parts), larger body size (282–298 × 215–232 versus 243–264 × 193–202 in *A. borhidii*, 249 × 166[2] in *A. quadrimaculata*, 212–219 × 155–160 in *A. rotundiceps* and 261 × 171 in *A. plowmanae*) and absence of a median pore (versus present in *A. borhidii*, *A. quadrimaculata* and *A. rotundiceps*).

Allogalumna paranovazealandica sp. n.

http://zoobank.org/5DB5344A-F409-47AF-AF3A-EBDBADD7F990

Figs 10–18

Diagnosis. Body size: 282–298 × 199–215. Rostral, lamellar and interlamellar setae minute. Bothridial setae with unilaterally slightly dilated, elongated, barbed in mediodistal part head. Anterior notogastral margin not developed. Four pairs of porose areas rounded. Median pore present. Postanal porose area elongate oval.

Description. *Measurements*. Body length: 282 (holotype: female), 282–298 (seven paratypes: two females and five males); notogaster width: 215 (holotype), 199–215 (seven paratypes). Without sexual dimorphism.

Integument. Body color brown. Body surface, pteromorphs, subcapitular mentum, genital and anal plates, and legs smooth.

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[2] Mahunka (1988) presented the following body size for *A. quadrimaculata* (systematic placement for this species in *Allogalumna* established by Ermilov and Bayartogtokh 2015): 389–405 × 275–300. We studied the sizes of two paratypes of *P. quadrimaculata*, and found 249 × 166. Hence, this corrected data could be used in future identification of *A. quadrimaculata*.

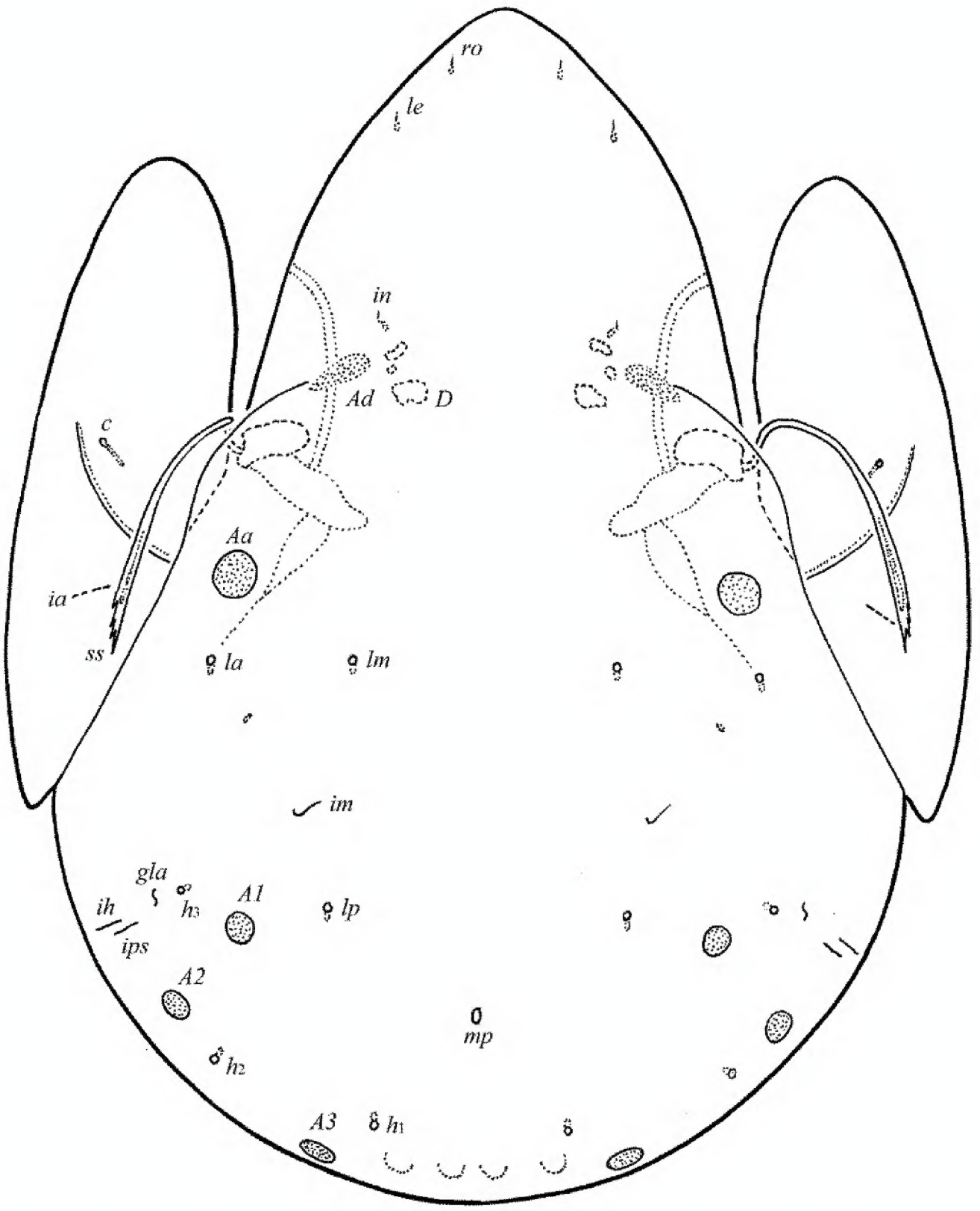


Figure 10. *Allogalumna paranovazealandica* sp. n., adult: dorsal view. Scale bar 50 μm.

Prodorsum (Figs 10, 12, 14). Rostrum broadly rounded. Sublamellar lines distinct, curving backwards. Rostral, lamellar and interlamellar setae minute (all 4), thin, smooth. Bothridial setae long (77–86), with unilaterally slightly dilated, elongated, barbed in medio-distal part head, directed postero-laterad. Exobothridial setae and their alveoli absent. Porose areas *Ad* elongate oval, transversally oriented (12–16 × 6–8).

Notogaster (Figs 10, 12, 13). Anterior notogastral margin not developed. Dorsophragmata of medium size, elongated longitudinally. Notogastral setae represented by 10 pairs of alveoli. Four pairs of porose areas rounded, with distinct margins: *Aa* (14–16)

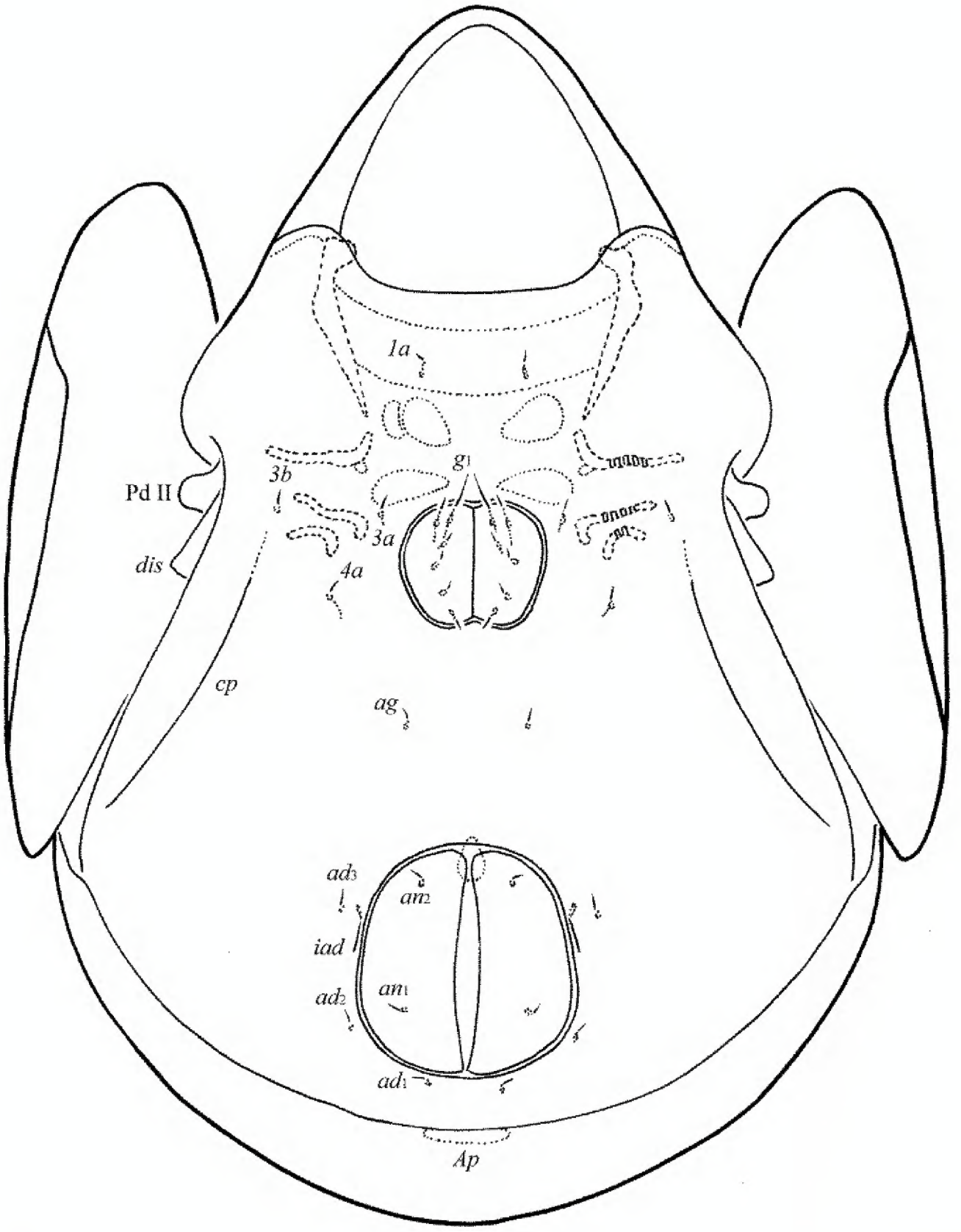


Figure 11. *Allogalumna paranovazealandica* sp. n., adult: ventral view (gnathosoma and legs not shown). Scale bar 50 μm.

larger than *A1*, *A2* and *A3* (all 6–10). Setal alveoli *la* inserted posteriorly to *Aa*. Median pore present in males and females, located between *A2*. All lyrifissures distinct, *im* located between setal alveoli *lm* and *lp*. Opisthonotal gland openings located laterally to *A1*.

Gnathosoma (Fig. 15). Morphology of subcapitulum, palps and chelicerae typical for most Galumnidae (for example, see Engelbrecht 1969, 1972; Ermilov and Anichkin 2010, 2011; Ermilov et al. 2011, 2013b; Bayartogtokh and Akrami 2014). Subcapitulum size: 73 × 61–65. Subcapitular setae setiform, smooth, *a* (12) longer

than *m* (8) and *h* (4), *a* thickest, *h* thinnest. Two pairs of adoral setae (6–8) thin, indistinctly barbed. Palps (61) with typical setation: 0–2–1–3–9(+ω). Axillary sacculi (*sac*) distinct. Chelicerae (82) with two setiform, barbed setae; *cha* (28) longer than *chb* (16). Trägårdh's organ long, tapered.

Epimeral and lateral podosomal regions (Fig. 11). Anterior tectum of epimere I smooth. Apodemes 1, 2, sejugal and 3 well visible. Four pairs of short (all 4), thin setae, setal formula: 1–0–1–2. Pedotecta II scale-like in lateral view, rounded distally in ventral view. Discidia sharply triangular. Circumpedal carinae indistinctly developed, directed to setae *3b*.

Anogenital region (Figs 11, 13, 16, 17). Six pairs of genital (g_1, 10; g_2–g_6, 4), one pair of aggenital (4), two pairs of anal (4) and three pairs of adanal (4) setae thin, smooth. Two genital setae on anterior edge of each genital plate. Adanal setae ad_3 inserted laterally to adanal lyrifissures. Postanal porose area elongate oval, transversally oriented (20 × 6–8).

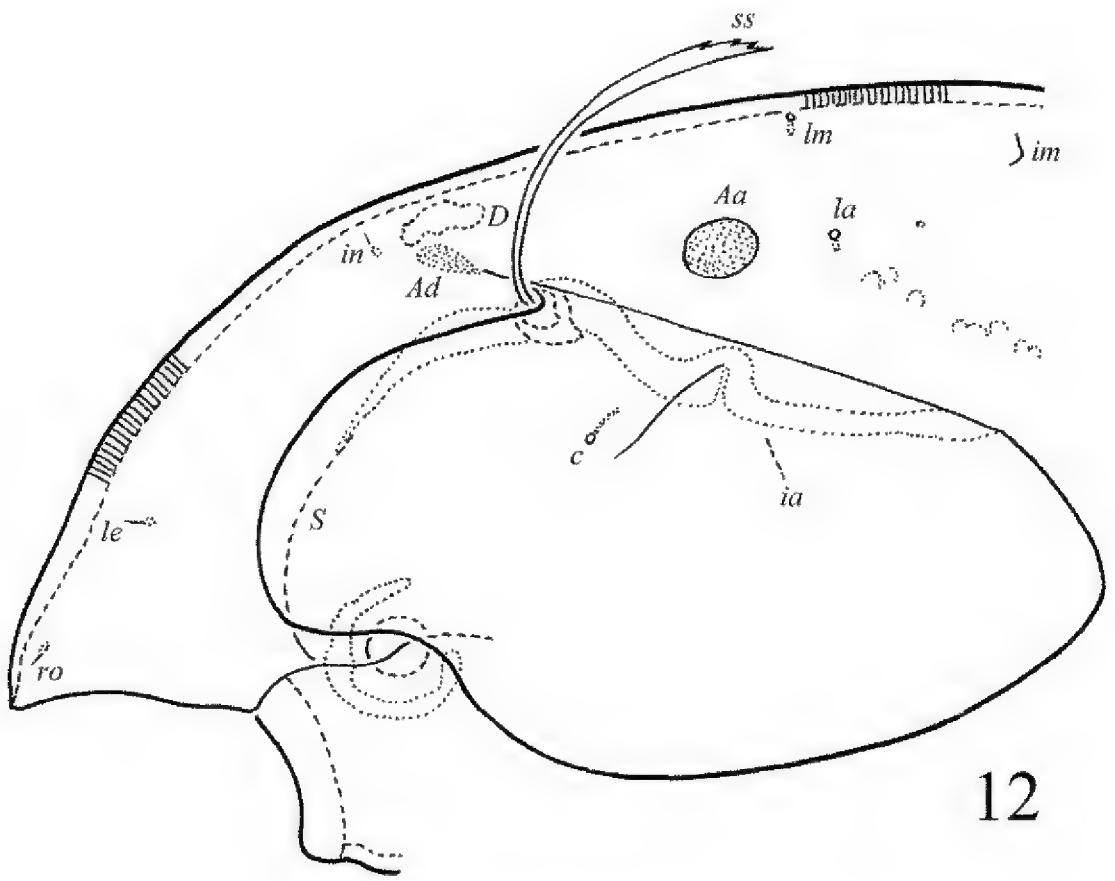
Legs (Fig. 18). Morphology of leg segments, setae and solenidia typical for most Galumnidae (for example, see Engelbrecht 1969, 1972; Ermilov and Anichkin 2010, 2011; Ermilov et al. 2011; Bayartogtokh and Akrami 2014). Tridactylous; claws smooth. Formulas of leg setation and solenidia: I (1–4–3–4–20) [1–2–2], II (1–4–3–4–15) [1–1–2], III (1–2–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in c Solenidion φ of tibiae IV inserted dorsally at about 2/3 length of segment.

Material examined. Holotype (female): Indonesia, Sumatra, Bukit Duabelas landscape, Jungle rubber agroforest, research site BJ5, 02°08'35.6"S, E 102°51'04.7"E, 51 m a.s.l., from upper soil layer (0–5 cm). Four paratypes (female and three males): Indonesia, Sumatra, Harapan landscape, Rubber plantation, research site HR2, 01°52'44.5"S, 103°16'28.4"E, 59 m a.s.l., from upper soil layer (0–5 cm). Three paratypes (female and two males): Indonesia, Sumatra, Harapan landscape, secondary rainforest, research site HF4, S 02°11'15.2"S, 103°20'33.4"E, from upper soil layer (0–5 cm). All specimens were collected by Bernhard Klarner (15.XI.2013) and determined and collected to morphospecies level by Dorothee Sandmann.

Type deposition. The holotype is deposited in LIPI (Indonesian Institute of Science) Cibinong, Indonesia; three paratypes are deposited in the collection of the Senckenberg Museum, Görlitz, Germany; four paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology. The specific name *paranovazealandica* refers to the morphological similarity of the new species to *Allogalumna novazealandica* Hammer, 1968.

Remarks. *Allogalumna paranovazealandica* sp. n. is most similar to *A. novazealandica* Hammer, 1968 from New Zealand in having minute prodorsal setae, long bothridial setae with slightly dilated head, four pairs of rounded notogastral porose areas, median pore and elongated postanal porose area. However, the new species differs from the latter by the shorter body length (282–298 versus 400–410 in *A. novazealandica*) and barbed in medio-distal part and curving postero-laterad bothridial setae (versus smooth and straight, directed upwards-laterally in *A. novazealandica*).



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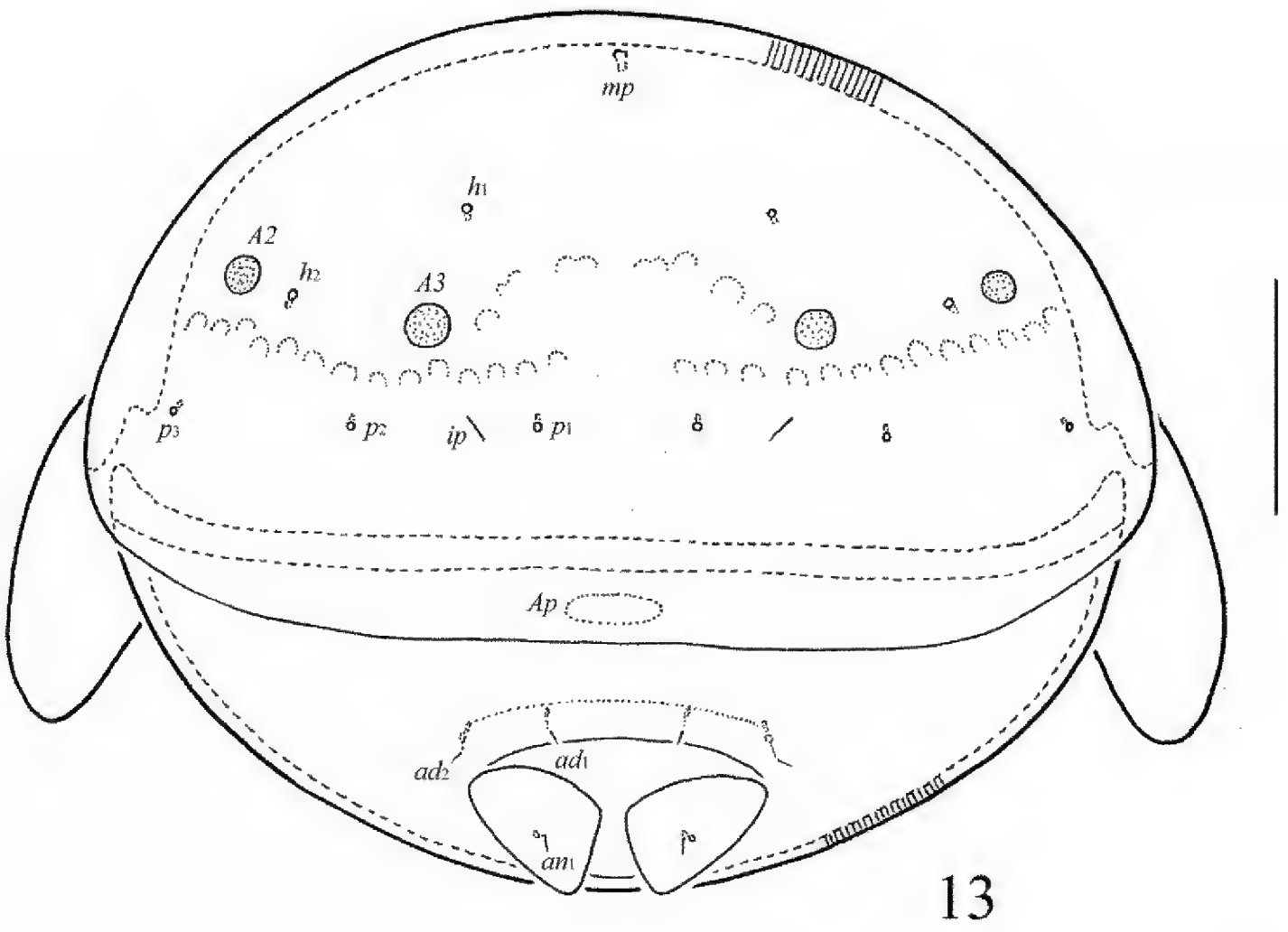

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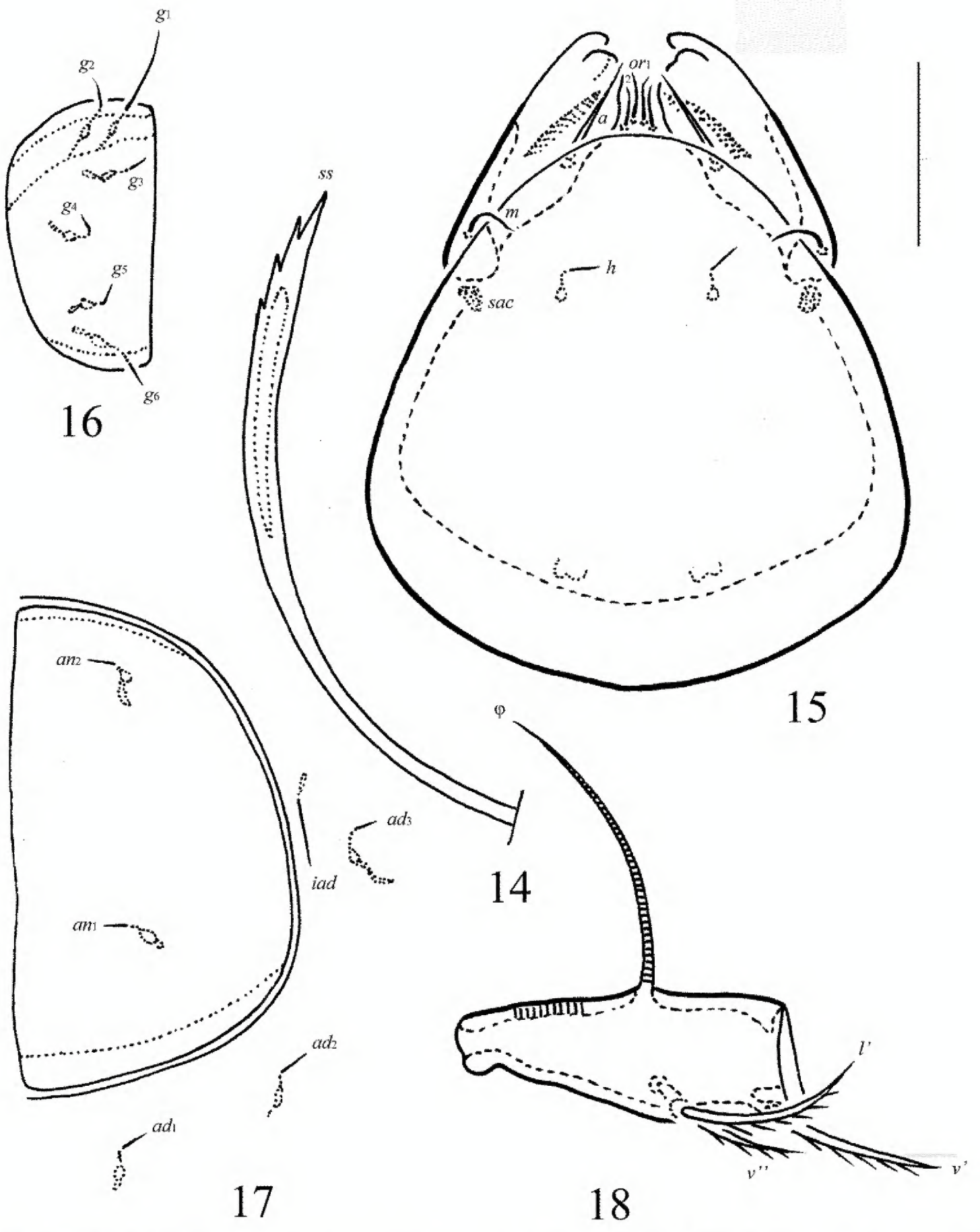
Figures 12–13. *Allogalumna paranovazealandica* sp. n., adult: **12** anterior part of body, lateral view (gnathosoma and leg I not shown) **13** posterior view. Scale bar 50 μm.



Figures 14–18. *Allogalumna paranovazealandica* sp. n., adult: **14** bothridial seta **15** subcapitulum, ventral view **16** genital plate, right **17** anal plate, left, and adanal setae **18** tibia of leg IV, left, antiaxial view. Scale bar 20 μm.

Acknowledgements

We cordially thank Prof. Dr. Badamdorj Bayartogtokh (National University of Mongolia, Ulaanbaatar, Mongolia) and an anonymous reviewer for valuable comments, Dr. László Dányi, Dr. Csaba Csuzdi and Edit Horváth (Hungarian National History Museum, Hungary) for loaning the paratypes of *Allogalumna quadrimaculata* (Mahunka, 1988), Kristina Richter (Georg August University Göttingen, Göttingen, Germany) for help in building up the Indonesian oribatid mite morphospecies collection, the State Ministry of Research and Technology of Indonesia (RISTEK) for the research permit and the Indonesian Institute of Sciences (LIPI) and Ministry of Forestry (PHKA) for the collection permit, the village heads, local site owners, PT REKI and Bukit Duabelas National Park for granting access to their properties and the many colleagues and helpers for support in the field.

Financial support was provided by the German Research Foundation (DFG) in the framework of the collaborative German – Indonesian research project CRC990 (EFForTS). The taxonomic study on Galumnoidea was supported by the Russian Foundation for Basic Research (project: 15-04-02706 A).

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